AEROLOGICAL SUMMARY

[Aerological Division, D. M. LITTLE in charge]

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During February 262 airplane and 193 radiosonde observations were made in the United States, and a few of the latter attained a maximum height of 18 kilometers. Only 28 percent of the radiosonde flights reached 16 kilometers, as compared to 46 percent in January. Beginning with February, additional pilot-balloon observations from 10 stations in the United States, Canada, Mexico, and Cuba were included in the upper-air charts. A complete description of tables 1, 1a, 2, 3, and 4, and charts VIII, IX, X, XI, and XII, which contain the aerological data for the current month, appeared in the January 1939 MONTHLY WEATHER REVIEW.

The weather during February was in marked contrast to that which prevailed in the preceding month when mean *surface* temperatures (°F.) everywhere, particularly in the Northwest, were abnormally excessive. But, during the current month, mean temperatures over all sections of the country west of the Mississippi Valley were decidedly below normal, while in the East the weather was somewhat warmer than normal. In the upper air, for all levels *above* the surface, the mean free-air temperature (° C.) for February was lowest over Fargo, N. Dak., and Sault Ste. Marie, Mich., up to 1.5 kilometers; over Fargo, N. Dak., from 2 to 10 kilometers; over Oakland, Calif., from 11 to 14 kilometers; over Nashville, Tenn., at 15 and 16 kilometers; and over Washington, D. C., at 17 kilometers. The highest mean free-air temperatures for the United States were found over Nashville, Tenn., Washington, D. C., and Oakland, Calif. But, above 10 kilometers, Sault Ste. Marie, Mich., became the warmest station, while Fargo, N. Dak., and Omaha, Nebr., were only slightly colder.

In the lower levels where upper-air observations are made by airplane and radiosonde, all stations, except Nashville, Tenn., Lakehurst, N. J., Washington, D. C., and Pensacola, Fla., definitely showed that lower mean temperatures prevailed during February than in the preceding month. The difference between the means for the two months was outstanding at Billings, Mont., where the temperatures for the current month ranged from 8.9° C. colder at the surface, to 6.6° C. colder at 5 kilometers. February, however, was only slightly colder at El Paso, Tex., Norfolk, Va., San Diego, Calif., and Seattle, Wash., at all levels. At the four stations where the February means were higher than in January, the temperature differences at each level were moderate, but, in this group, Washington, D. C., had the largest average difference of +1.6° C.

Above 5 kilometers, Oakland, Calif., had lower mean temperatures in February than during January at all levels up to 18 kilometers. But, on the other hand, Nashville, Tenn., was warmer in February at all levels up to 17 kilometers. And, at both of these stations, the temperature differences between the current month and January increased steadily with altitude.

February mean temperatures were lower than during the preceding month at all levels from the surface up to 9 kilometers over Oklahoma City, Okla.; up to 10 kilometers over Omaha, Nebr.; and up to 11 kilometers over Fargo, N. Dak., and Sault Ste. Marie, Mich. Above these levels it was found that the February temperatures were warmer than in January, with the monthly differences for each level increasing with altitude. This difference was as much as +6.8° C. over Omaha, Nebr., at 18 kilometers. Conditions, however, were the opposite over Washington, D. C., for the current month was warmer than January at all levels up to 10 kilometers, and then steadily colder by as much as −5.1° C. at 17 kilometers.

The distribution of mean free-air pressures for February was such that low pressure prevailed generally over the northern Great Lakes region and east and northeastward over the entire St. Lawrence valley to Newfoundland, where slightly lower pressure was centered. In the United States, however, the lowest pressure occurred over Sault Ste. Marie, Mich., up to 5 kilometers, and over Fargo, N. Dak., at all higher levels. High presssure centered over the South, being noted at Pensacola, Fla., below 5 kilometers, and over Nashville, Tenn., above 5 kilometers. The difference in pressures between these two northern and southern "low" and "high" areas was found to increase at each level with altitude, becoming 31 millibars at 5 kilometers, and then decreasing with altitude to 9 millibars at 15 kilometers. The highest pressures for the month of February were essentially the same at each level as those which were recorded during the previous month, but the current low pressures became steadily less with altitude at all levels, ranging from 1 to 4 millibars, at 2 and 12 kilometers, respectively.

Mean relative humidity was highest during February over the upper Mississippi valley and the northern Great Lakes region. Comparatively high humidities also were found over the Northwest and the northern Rocky Mountain regions. Low mean humidities appeared over Norfolk, Va., in all levels up to 2.5 kilometers, and over Pensacola, Fla., and El Paso, Tex., at all levels above 3 kilometers. Extremes of humidity ranged from 94 percent at 0.5 and 1 kilometer over Sault Ste. Marie, Mich., to 25 percent over Pensacola, Fla., and El Paso, Tex., at 5 kilometers.

The resultant wind directions, as shown in table 2 and on charts VIII to XI, inclusive, showed a rather uniform flow of air at all levels. Winds from the northwest quadrant covered the entire Northwest, where the February weather was below normal. But in the eastern and southern areas, where surface temperatures were above normal, the resultant winds were westerly and southwesterly, even up to 5 kilometers. Northwesterly and northerly winds prevailed along the Pacific coast. In the far South, particularly in Cuba and portions of Mexico, the resultant directions had southerly and easterly components. Such distribution gave a smooth "stream-line" effect to the entire mass movement of the atmosphere in February, as shown in charts VIII, IX, X, and XI.

Table 2 shows resultant winds and velocities based on 5 p. m. (E. S. T.) observations. Comparing many of these winds with the normals for 5 a. m. (E. S. T.) observations, it was found that, at Atlanta, Ga., Nashville, Tenn., Washington, D. C., St. Louis. Mo., Brooklyn, N. Y., Chicago, Ill., and Sault Ste. Marie, Mich., the resultant wind directions "backed" at all levels by departing decidedly from the normals in counterclockwise rotations. But, at Medford, Oreg., Salt Lake City, Utah, Seattle, Wash., and Billings, Mont., all departures at every level

turned away from normal with a clockwise rotation. Medford, Oreg., exhibited the largest tendency to depart widely from its normal directions at all levels.

Charts VIII and IX show resultant wind directions at 1.5 and 3 kilometers, respectively, based on 5 a. m. observations, while table 2 shows those based on 5 p. m. observations. Of all the 5 a. m. winds shown on these charts, 54 percent were northwesterly and 37 percent southwesterly at 1.5 kilometers; and 89 percent northwesterly and 11 percent southwesterly at 3 kilometers. But, of all the 5 p. m. wind resultants, as shown in table 2, 47 percent were northwesterly and 53 percent southwesterly at 1.5 kilometers, and 65 percent northwesterly and 35 percent southwesterly, at 3 kilometers. At 4 and 5 kilometers 70 percent of the directions were northwesterly and 30 percent southwesterly, respectively, while at 8 kilometers all wind directions had northwesterly components.

Resultant wind velocities, when compared to existing 5 a. m. normals, indicated that large departures from normal did not occur along with large directional departures, except at Houston, Tex., Oakland, Calif., and San Diego, Calif. In all cases, where the current velocity departures were greater than 3 meters per second, the differences were positive, or greater than normal, being as much as +15.4 m. p. s. over Brooklyn, N. Y., at 4 kilometers; +13.2 m. p. s. at Oakland, Calif.; +16.7 m. p. s. over Houston, Tex.; +12.5 m. p. s. over Oklahoma City, Okla.; and +12.3 m. p. s. over Omaha, Nebr.; all at 5 kilometers. The maximum resultant wind speed for the month was 36.5 m. p. s. (81.6 miles per hour) over Albuquerque, N. Mex., at 10 kilometers.

The highest resultant wind velocities were confined mostly to the eastern portion of the United States, particularly at 4 and 5 kilometers. At 1.5 kilometers the highest velocities occurred over the Ohio Valley, Great Lakes region, the northeastern States and New Brunswick. Relatively high wind speeds existed along the Pacific coast, upper Missouri Valley and northern Rocky Mountain region, as well as Cuba. At 3 kilometers the highest velocities were centered over the Middle Atlantic States, Ohio Valley, and lower Lake region, as well as the central Pacific coast areas. The lowest velocities occurred in the far South (southern Florida and Cuba). At 4 kilometers the highest velocities were found over the Ohio Valley, the northeastern States and the entire Pacific coast, while lower velocities occurred over the central Rocky Mountain region, Florida and Cuba. But, at 5 kilometers, the area of greatest velocities covered most of the country, particularly the lower Mississippi and Ohio Valleys, and the west Gulf States. Considerably lower resultant velocities were noted over the central Rocky Mountain region and portions of the upper Missouri Valley, as well as Florida and Cuba.

Maximum free-air wind velocities for February are given in table 3. A wind speed of 49 meters per second (109.6 miles per hour) was recorded over Sandberg, Calif., at 2.5 kilometers; 62 m. p. s. (138.6 miles per hour) over Harrisburg, Pa., at 3.6 kilometers; and 91 m. p. s. (203.6 miles per hour) over Las Vegas, Nev., at 9.4 kilometers. This latter wind speed was the second highest to be recorded in the United States, being surpassed only by the record of 95.5 m. p. s. (213.6 miles per hour) established over Albuquerque, N. Mex., in January 1939, and nearly equalled by 90 m. p. s. (201.3 miles per hour), observed in November 1938, over Winslow, Ariz., at 12 kilometers.

The mean insentropic chart [1] for February is characterized by three anticyclonic moist eddies. The two moist eddies, one of which enters on the Texas coast and extends to Sault Ste. Marie, the other extending east of the Appalachians to northern New York, seem to correspond to large positive departures of precipitation from normal west of the Mississippi to Iowa, along the Appalachians and the eastern seaboard to the Great Lakes and New England. The third moist eddy enters near Portland, Oreg., and does not seem to correspond to any significant departures of precipitation from normal, although a band of slight precipitation excess follows the center of moisture closely.

This chart differs from those for February 1935, 1936, and 1937, which show dry downslope winds in the eastern part of the country and have the main source of moisture in the southern plateau region; a corresponding difference in precipitation distribution is present. A further difference is in the winds which for the 1939 chart show more of a northerly component on the Pacific coast and more southerly on the Atlantic coast than in the other three Februarys.

[1] This chart and the following discussion have been prepared by the Air Mass Section of the Meteorological Research Division.

TABLE 1.—*Mean free-air barometric pressures (P.) in mb, temperatures (T.) in °C, and relative humidities (R. H.) in percent obtained by airplanes during February 1939*

Stations and elevations in meters above sea level	Altitude (meters) m. s. l.																													
	Surface				500			1,000			1,500			2,000			2,500			3,000			4,000			5,000					
	Number of observations	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.	P.	T.	R. H.			
Billings, Mont. (1,090 m.)	26	889	−9.0	71							843	−7.2	65	790	−9.2	65	740	−11.1	66	693	−14.1	68	607	−20.5	67	528	−27.6	66			
Cheyenne, Wyo. (1,873 m.)	28	805	−10.0	68										792	−8.1	64	742	−9.2	61	696	−12.0	59	610	−18.0	55	532	−25.2	53			
Chicago, Ill. (187 m.)	28	994	−5.0	82	955	−5.9	81	897	−5.9	71	842	−6.0	61	789	−7.5	57	740	−9.4	55	693	−11.6	56	607	−16.8	56	531	−22.4	54			
Coco Solo, C. Z.[1] (15 m.)	28	1,012	24.9	81	957	21.3	91	904	18.2	90	852	15.2	83	803	12.9	73	756	12.5	44	713	10.9	27	631	5.7	17	558	.3	13			
El Paso, Tex. (1,193 m.)	28	880	2.0	44							848	4.9	40	797	1.9	39	749	−.9	38	703	−3.7	34	618	−9.2	33	543	−15.2	26			
Lakehurst, N. J.[1] (39 m.)	23	1,018	−.3	77	961	.7	66	903	−.5	58	849	−1.5	52	797	−3.3	52	748	−5.7	51	702	−8.4	50	616	−14.0	48	539	−19.6	48			
Norfolk, Va.[1] (10 m.)	15	1,025	2.8	73	964	4.0	48	907	2.3	41	852	.2	36	800	−1.0	33	752	−3.0	33	706	−5.4	31	620	−10.7	27	544	−16.2	31			
Pearl Harbor, T. H.[1] (6 m.)	28	1,016	20.6	84	960	20.3	73	906	17.4	77	854	14.7	76	804	13.1	64	758	11.3	52	714	9.0	46	631	3.8	40	558	−.6	32			
Pensacola, Fla.[1] (13 m.)	17	1,021	9.8	84	964	10.2	70	907	9.9	59	854	8.7	49	804	7.3	42	756	5.2	35	710	2.4	31	627	−2.6	21	552	−7.6	25			
St. Thomas, V. I.[1] * (8 m.)																															
Salt Lake City, Utah (1,288 m.)	28	872	−6.4	84							848	−4.1	73	796	−6.4	69	746	−9.6	74	699	−13.0	78	613	−18.2	73	535	−24.8	63			
San Diego, Calif.[1] (10 m.)	26	1,019	6.9	80	960	8.3	73	904	6.1	68	850	3.9	63	800	1.7	58	751	−.3	52	705	−2.6	48	621	−7.3	44	546	−14.1	42			
Seattle, Wash.[1] (10 m.)	18	1,020	3.9	81	960	1.1	80	902	−2.0	80	847	−4.7	71	794	−7.8	66	744	−10.3	64	697	−12.1	54	610	−17.9	49	534	−25.0	67			
Spokane, Wash. (597 m.)	25	946	−3.5	80				900	−3.5	72	844	−5.9	70	792	−8.5	70	742	−11.3	69	695	−14.3	67	608	−20.4	64	530	−26.7	63			

* Flights discontinued temporarily.
Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.
[1] Navy.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

TABLE 1a.—*Mean free-air barometric pressures (P.) in mb, temperatures (T.) in °C., and relative humidities (R. H.) in percent obtained by radiosonde during February 1939*

Altitude (meters) m. s. l.	Stations and elevations in meters above sea level																							
	Fargo, N. Dak. (274 m.)				Nashville, Tenn. (180 m.)				Oakland, Calif. (2 m.)				Oklahoma City, (391 m.)				Omaha, Nebr. (300 m.)				Sault Ste. Marie, Mich. (221 m.)				Washington, D. C. (13 m.)[1]			
	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.	Number of Observations	P.	T.	R. H.
Surface	28	984	−19.8	90	28	997	4.8	81	28	1,021	6.4	81	28	970	−0.8	71	28	981	−8.6	75	28	988	−12.5	91	25	1,020	3.1	74
500	28	955	−17.2	90	28	959	4.9	76	28	961	6.4	76	28	957	−.4	71	28	957	−8.7	67	28	952	−12.8	94	25	960	2.2	67
1,000	28	894	−14.4	89	28	902	3.7	72	28	905	4.3	70	28	900	1.1	65	28	896	−7.8	58	28	892	−13.4	94	25	903	1.2	66
1,500	28	836	−13.7	86	28	848	2.6	64	28	850	2.1	64	28	846	1.5	59	28	841	−7.4	54	28	835	−13.7	91	25	848	0.0	67
2,000	28	783	−14.6	83	28	797	.8	62	28	799	−.2	60	28	794	−.5	53	28	788	−9.0	54	28	782	−14.0	87	25	797	−1.4	65
2,500	28	733	−16.2	80	28	748	−1.2	59	28	750	−2.5	57	28	746	−2.7	48	28	739	−11.2	54	28	732	−15.6	83	25	748	−3.2	62
3,000	28	685	−18.3	78	28	702	−3.3	59	28	704	−5.3	55	28	700	−5.5	46	28	692	−13.3	54	28	685	−17.8	79	25	702	−5.4	58
4,000	28	599	−23.5	77	28	619	−7.8	51	27	619	−10.6	49	28	616	−10.7	44	27	606	−18.8	54	28	598	−23.1	75	25	617	−10.7	54
5,000	28	521	−29.6	77	28	544	−13.4	48	27	543	−16.5	49	28	540	−16.8	42	26	530	−24.9	54	28	521	−28.4	71	25	541	−16.3	49
6,000	28	452	−36.1	75	28	476	−19.5	47	26	474	−22.7	49	28	472	−24.2	41	25	461	−31.3	52	27	453	−34.2	69	25	473	−22.0	48
7,000	28	391	−43.2	..	28	415	−26.1	47	25	413	−29.1	47	27	411	−31.0	39	24	400	−37.5	50	27	391	−40.9	67	24	412	−28.2	48
8,000	28	336	−50.7	....	28	361	−32.8	46	25	359	−36.2	46	26	356	−37.6	39	24	345	−44.3	....	26	337	−47.7	....	24	358	−34.6	....
9,000	28	288	−55.4	....	28	313	−39.5	45	24	310	−43.7	45	25	307	−43.9	....	24	296	−49.2	....	22	289	−52.1	....	21	309	−41.2	....
10,000	28	246	−56.9	....	28	269	−47.1	....	22	266	−50.3	....	25	264	−49.5	....	23	254	−52.5	....	19	247	−53.0	....	18	266	−48.3	....
11,000	26	210	−55.9	....	24	231	−53.6	....	21	228	−56.2	....	20	226	−54.2	....	23	218	−53.8	....	17	212	−52.6	....	17	228	−54.5	....
12,000	23	179	−54.9	....	21	197	−58.7	....	18	195	−61.3	....	16	194	−56.0	....	22	186	−54.5	....	15	181	−52.2	....	15	195	−57.7	....
13,000	21	153	−54.3	....	19	168	−60.3	....	16	165	−63.4	....	9	166	−58.0	....	19	159	−55.1	....	13	155	−52.1	....	15	167	−60.2	....
14,000	19	131	−54.5	....	17	142	−61.9	....	14	140	−62.2	....	----	----	----	....	16	136	−55.9	....	11	133	−52.7	....	10	142	−60.6	....
15,000	17	112	−55.5	....	15	121	−64.8	....	11	119	−63.2	....	----	----	----	....	15	116	−57.0	....	8	114	−53.4	....	8	121	−62.8	....
16,000	12	96	−56.6	....	13	102	−66.0	....	8	100	−65.4	....	----	----	----	....	10	99	−57.8	....	5	96	−54.9	....	6	103	−65.4	....
17,000	----	----	----	....	9	86	−67.3	....	7	85	−67.3	....	----	----	----	....	9	84	−59.2	....	----	----	----	....	5	87	−68.3	....
18,000	----	----	----	....	----	----	----	....	5	71	−67.8	....	----	----	----	....	6	71	−59.2	....	----	----	----	....	----	----	----	....

Observations taken about 4 a. m. 75th meridian time, except by Navy stations along the Pacific coast and Hawaii where they are taken at dawn.

[1] Navy.

NOTE.—None of the means included in this table are based on less than 15 surface or 5 standard-level observations.

Number of observations refers to pressure only as temperature and humidity data are missing for some observations at certain levels, also the humidity data are missing for some observations at certain levels, also the humidity data are not used in daily observations when the temperature is below −40° C.

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during February 1939*

[Directions given in degrees from North (N=360°, E=90°, S=180°, W=270°)—Velocities in meters per second (superior figures indicate number of observations)]

Altitude (meters) m. s. l.	Abilene, Tex. (537 m.)		Albuquerque, N. Mex. (1,554 m.)		Atlanta, Ga. (302 m.)		Billings, Mont. (1,095 m.)		Boise, Idaho (850 m.)		Brooklyn, N. Y. (15 m.)		Brownsville, Tex. (7 m.)		Buffalo, N. Y. (220 m.)		Burlington, Vt. (132 m.)		Charleston, S. C. (18 m.)		Cheyenne, Wyo. (1,873 m.)		Chicago, Ill. (192 m.)		Cincinnati, Ohio (157 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	212	1.6[37]	287	1.7[38]	215	1.7[36]	262	2.4[38]	317	1.5[33]	268	3.3[32]	124	1.9[34]	247	4.6[37]	199	2.5[34]	177	1.9[28]	298	4.7[32]	244	2.5[28]	250	3.0[28]
500	----	----	----	----	213	1.8[36]	----	----	----	----	271	5.9[32]	131	1.8[34]	239	8.3[37]	210	6.2[29]	203	5.7[37]	----	----	231	4.6[37]	238	6.0[35]
1,000	241	3.3[37]	----	----	244	3.7[34]	----	----	322	1.9[35]	272	9.1[31]	154	1.3[32]	243	12.2[30]	251	8.6[30]	221	7.4[34]	----	----	247	7.7[32]	227	7.3[31]
1,500	235	5.3[32]	----	----	251	7.0[33]	262	5.5[28]	305	4.1[35]	268	14.3[19]	285	2.1[30]	252	12.6[18]	276	11.8[17]	233	10.5[31]	----	----	270	11.3[19]	245	11.5[18]
2,000	254	8.1[30]	271	3.1[35]	256	11.5[31]	282	7.6[37]	302	6.7[35]	276	17.7[17]	264	6.4[16]	259	13.3[12]	278	15.4[13]	245	12.8[17]	295	5.6[32]	269	14.5[16]	250	14.5[17]
2,500	253	11.1[36]	268	4.6[38]	261	13.7[16]	287	8.7[36]	303	8.0[32]	274	19.8[16]	241	10.5[12]	----	----	298	17.4[16]	269	11.9[11]	292	7.4[33]	271	16.8[15]	265	14.9[13]
3,000	251	15.3[30]	275	8.0[37]	265	15.5[13]	289	10.7[32]	318	9.6[17]	272	19.3[12]	248	10.9[11]	----	----	----	----	268	14.7[11]	285	9.8[31]	275	18.2[13]	268	19.3[10]
4,000	254	21.3[30]	278	14.6[36]	265	17.0[10]	296	13.1[14]	342	14.8[13]	265	24.9[10]	----	----	----	----	----	----	----	----	293	11.6[15]	----	----	----	----
5,000	260	26.2[16]	271	20.9[34]	----	----	314	16.4[11]	----	----	----	----	----	----	----	----	----	----	----	----	290	10.8[15]	----	----	----	----
6,000	258	33.3[13]	273	25.8[18]	----	----	311	16.9[11]	----	----	----	----	----	----	----	----	----	----	----	----	284	12.9[15]	----	----	----	----
8,000	----	----	271	34.6[10]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
10,000	----	----	270	36.5[10]	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Altitude (meters) m. s. l.	El Paso, Tex. (1,196 m.)		Fargo, N. Dak. (283 m.)		Greensboro, N. C. (271 m.)		Havre, Mont. (766 m.)		Houston, Tex. (21 m.)		Huron, S. Dak. (393 m.)		Las Vegas, Nev. (570 m.)		Little Rock, Ark. (— m.)		Medford, Oreg. (410 m.)		Miami, Fla. (10 m.)		Minneapolis, Minn. (261 m.)		Nashville, Tenn. (194 m.)		New Orleans, La. (19 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	266	4.6[32]	328	4.0[35]	244	2.0[34]	282	1.8[35]	109	1.8[37]	320	3.4[37]	13	2.8[37]	----	----	316	1.7[36]	127	4.6[32]	264	2.2[37]	200	2.1[36]	142	2.0[36]
500	----	----	305	3.3[32]	223	4.0[34]	----	----	153	3.4[35]	318	4.0[37]	----	----	----	----	311	1.7[33]	133	4.7[36]	265	3.7[37]	203	3.8[33]	177	5.0[36]
1,000	----	----	303	5.7[31]	227	7.0[34]	270	4.0[35]	183	1.4[36]	300	5.0[35]	5	2.6[37]	----	----	294	2.2[33]	153	3.6[34]	282	6.8[33]	207	5.9[35]	192	5.6[32]
1,500	272	4.2[18]	306	8.7[31]	251	10.2[33]	284	8.2[35]	284	4.8[17]	289	6.6[20]	329	2.6[37]	----	----	285	3.2[33]	195	2.9[32]	291	9.9[31]	226	8.7[31]	231	6.4[19]
2,000	263	4.8[18]	299	11.3[30]	256	12.9[32]	294	11.5[34]	264	8.1[14]	288	9.2[18]	310	5.2[27]	----	----	312	4.4[31]	221	3.4[19]	285	13.2[18]	245	11.0[17]	254	8.4[14]
2,500	260	7.2[26]	295	11.6[17]	261	16.3[17]	298	11.9[33]	260	10.9[14]	291	10.7[13]	312	8.1[34]	----	----	335	8.5[17]	244	3.8[11]	286	11.8[17]	255	13.4[16]	257	11.0[13]
3,000	261	11.8[25]	296	13.0[17]	268	18.8[18]	297	10.5[16]	266	15.6[11]	289	10.9[17]	319	8.9[33]	----	----	343	10.0[13]	----	----	285	12.2[16]	259	15.5[18]	----	----
4,000	261	17.6[23]	288	17.6[18]	267	21.4[10]	----	----	264	19.3[11]	283	13.0[18]	317	13.4[21]	----	----	----	----	----	----	284	14.0[14]	274	21.2[17]	----	----
5,000	264	21.6[22]	289	17.8[13]	----	----	----	----	264	24.7[10]	285	15.6[14]	320	17.1[18]	----	----	----	----	----	----	280	12.4[10]	----	----	----	----
6,000	259	27.9[17]	284	19.0[13]	----	----	----	----	----	----	288	16.3[13]	320	22.6[16]	----	----	----	----	----	----	----	----	----	----	----	----
8,000	----	----	274	19.9[10]	----	----	----	----	----	----	282	17.2[10]	314	27.8[12]	----	----	----	----	----	----	----	----	----	----	----	----
10,000	----	----	----	----	----	----	----	----	----	----	278	18.3[10]	----	----	----	----	----	----	----	----	----	----	----	----	----	----

TABLE 2.—*Free-air resultant winds based on pilot-balloon observations made near 5 p. m. (E. S. T.) during February 1939*—Continued

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)		Oklahoma, City, Okla. (402 m.)		Omaha, Nebr. (306 m.)		Reno, Nev. (1,346 m.)		St. Louis, Mo. (170 m.)		Salt Lake City, Utah (1,294 m.)		San Diego, Calif. (15 m.)		San Juan, P. R. (16 m.)		Sault Ste. Marie, Mich. (198 m.)		Seattle, Wash. (14 m.)		Spokane, Wash. (603 m.)		Washington, D. C. (10 m.)		Winslow, Ariz. (1,488 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	281	3. 2^{25}	283	1. 5^{38}	308	3. 1^{33}	360	1. 0^{25}	225	0. 9^{26}	226	2. 1^{28}	286	3. 6^{37}	67	6. 7^{28}	274	3. 9^{19}	195	1. 5^{24}	209	1. 5^{36}	263	1. 5^{34}	263	2. 6^{26}
500	333	3. 6^{31}	272	1. 6^{28}	306	3. 9^{28}	-----	-----	230	2. 5^{36}	-----	-----	304	2. 7^{37}	82	8. 8^{28}	280	5. 2^{19}	210	2. 9^{24}	-----	-----	240	3. 6^{34}	-----	-----
1,000	352	5. 0^{26}	236	2. 4^{25}	299	4. 4^{27}	-----	-----	232	5. 7^{33}	-----	-----	340	3. 5^{26}	91	7. 8^{27}	286	5. 2^{19}	236	3. 5^{17}	219	2. 8^{26}	239	6. 1^{32}	-----	-----
1,500	350	8. 2^{21}	236	6. 2^{32}	288	7. 7^{35}	338	1. 5^{35}	245	9. 0^{18}	215	2. 7^{28}	341	5. 3^{35}	93	7. 6^{24}	294	8 6^{13}	256	3. 8^{14}	249	4. 4^{24}	263	10. 0^{20}	-----	-----
2,000	355	9. 2^{20}	257	9. 6^{32}	276	10. 6^{33}	300	2. 7^{30}	256	11. 8^{15}	233	2. 2^{25}	324	5. 8^{33}	92	6. 7^{17}	297	9. 9^{12}	286	6. 0^{10}	278	5. 7^{19}	270	13. 2^{20}	264	3. 5^{37}
2,500	357	10. 2^{16}	258	11. 6^{32}	279	12. 7^{30}	307	4. 7^{27}	273	15. 4^{13}	267	3. 2^{26}	323	8. 4^{32}	91	6. 5^{13}	288	11. 7^{12}	-----	-----	296	6. 4^{17}	272	15. 8^{19}	269	5. 4^{37}
3,000	350	14. 0^{16}	252	14. 2^{21}	270	14. 5^{19}	327	7. 2^{25}	277	15. 6^{10}	284	4. 7^{30}	331	11. 1^{30}	84	6. 4^{13}	-----	-----	-----	-----	312	8. 7^{15}	282	17. 7^{13}	273	6. 4^{37}
4,000	343	18. 0^{13}	261	17. 9^{17}	277	18. 5^{18}	346	15. 2^{15}	-----	-----	321	8. 8^{11}	317	11. 5^{16}	-----	-----	-----	-----	-----	-----	315	12. 9^{12}	-----	-----	286	10. 9^{34}
5,000	-----	-----	259	25. 5^{16}	274	22. 7^{12}	339	19. 6^{13}	-----	-----	-----	-----	314	15. 2^{14}	-----	-----	-----	-----	-----	-----	322	15. 9^{10}	-----	-----	292	14. 7^{30}
6,000	-----	-----	269	30. 0^{12}	272	25. 8^{12}	339	24. 0^{13}	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	292	18. 1^{19}
8,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	294	25. 6^{17}
10,000	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	288	27. 2^{13}

TABLE 3.—*Maximum free-air wind velocities (M. P. S.) for different sections of the United States based on pilot-balloon observations during February 1939*

Section	Surface to 2,500 meters (m. s. l.)					Between 2,500 and 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) M. S. L.	Date	Station	Maximum velocity	Direction	Altitude (m.) M. S. L.	Date	Station	Maximum velocity	Direction	Altitude (m.) M. S. L.	Date	Station
Northeast [1]	46.4	WNW	2,260	11	Brooklyn, N. Y.	62.0	WSW	3,620	20	Harrisburg, Pa.	61.0	W	9,880	13	Cleveland, Ohio.
East-Central [2]	45.4	SSW	1,830	2	Knoxville, Tenn.	45.6	W	5,000	11	Nashville, Tenn.	58.0	W	8,670	12	Knoxville, Tenn.
Southeast [3]	40.0	NW	2,500	7	Spartanburg, S. C.	50.0	W	4,300	22	Spartanburg, S. C.	45.4	WSW	5,870	4	Charleston, S. C.
North-Central [4]	43.5	WSW	1,550	10	Detroit, Mich.	46.8	WNW	4,650	17	Fargo, N. Dak.	57.0	WSW	10,640	18	Huron, S. Dak.
Central [5]	46.8	WSW	1,960	19	Wichita, Kans.	54.0	WSW	4,680	1	Omaha, Nebr.	72.0	WSW	9,560	11	Wichita, Kans.
South-Central [6]	41.0	SSW	1,390	16	Oklahoma City, Okla.	53.2	NNW	3,280	2	Del Rio, Tex.	71.0	SW	7,710	5	Abilene, Tex.
Northwest [7]	36.1	W	1,760	18	Havre, Mont.	39.6	NNW	3,820	15	Boise, Idaho	65.5	NNE	9,670	16	Billings, Mont.
West-Central [8]	35.2	NW	2,290	1	Cheyenne, Wyo.	47.8	NW	4,270	15	Redding, Calif.	86.0	ENE	17,760	17	Denver, Colo.
Southwest [9]	49.0	NNW	2,500	26	Sandberg, Calif.	59.1	NNW	2,750	26	Sandberg, Calif.	91.0	N	9,420	13	Las Vegas, Nev.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

TABLE 4.—*Mean altitudes and temperatures of significant points identifiable as tropopauses during February 1939, classified according to the potential temperatures (10-degree intervals between 290 and 399° A.) with which they are identified. (Based on radiosonde observations.) All actual temperatures are in degrees centigrade below zero*

Potential temperatures °A.	Fargo, N. Dak.			Nashville, Tenn.			Oakland, Calif.			Oklahoma City, Okla.			Omaha, Nebr.			Sault Ste. Marie, Mich.			Washington, D. C.		
	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature	Number of cases	Mean altitude	Mean temperature
290–299	10	6.6	44.4	-----	-----	-----	1	5.3	33.0	1	7.4	44.0	3	6.1	35.3	12	6.2	41.0	-----	-----	-----
300–309	25	8.5	55.2	1	7.4	47.0	3	7.4	43.0	4	7.4	42.2	13	7.8	46.5	21	7.7	48.4	1	7.1	45.0
310–319	10	9.6	59.5	3	7.8	35.7	7	8.8	46.8	10	8.5	44.6	14	9.2	53.0	9	8.7	51.9	4	8.4	39.2
320–329	6	10.2	58.3	17	9.7	47.6	12	10.4	61.1	13	10.2	52.9	15	10.0	53.7	12	10.1	57.1	7	11.1	60.4
330–339	2	11.2	62.5	12	11.6	59.2	9	12.0	63.1	6	11.3	58.8	6	10.7	54.2	1	11.5	61.0	8	11.4	59.1
340–349	-----	-----	-----	13	12.3	60.2	5	13.3	69.2	3	11.4	54.7	6	11.5	57.7	-----	-----	-----	1	13.0	65.0
350–359	1	12.4	62.0	1	12.8	60.0	-----	-----	-----	1	12.4	55.0	1	11.5	52.0	5	11.7	53.6	-----	-----	-----
360–369	1	12.3	55.0	1	14.0	64.0	-----	-----	-----	-----	-----	-----	6	12.8	56.8	1	12.5	54.0	3	13.2	57.3
370–379	2	13.4	53.5	2	14.9	68.0	1	13.7	59.0	-----	-----	-----	2	13.8	60.0	3	13.3	56.3	1	13.7	58.0
380–389	-----	-----	-----	4	15.7	68.2	1	15.1	65.0	2	14.5	61.5	4	13.9	58.0	-----	-----	-----	-----	-----	-----
390–399	1	14.3	54.0	-----	-----	-----	-----	-----	-----	-----	-----	-----	3	15.0	56.7	-----	-----	-----	-----	-----	-----
All (weighted mean)	-----	9.3	54.7	-----	11.4	55.4	-----	10.8	58.0	-----	10.0	51.0	-----	10.3	52.8	-----	8.7	50.2	-----	11.0	55.7
Mean potential temperature, °A.	313.3			338.6			329.0			326.8			331.7			316.3			333.5		